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Remarks and Replies

Process-Specific Constraints in Optimality Theory

John J. McCarthy

Similar phonological processes can be governed by different constraints. Davis (1995) claims that the effect of such *process-specific constraints* cannot be obtained in Optimality Theory (OT), exemplifying this point with material from harmony in Palestinian Arabic. On the contrary, I show that process-specific constraints are a natural and expected result of *constraint ranking*, the fundamental idea of OT. Furthermore, OT makes a restrictive prediction, the subset criterion, about coexistent process-specific constraints within a single grammar—a prediction supported by the Palestinian material.

Davis also presents evidence that epenthetic segments have featural specifications, claiming that OT says they are featureless. This is incorrect; OT is a model of constraint interaction, not of the representation of epenthetic segments.

Keywords: Arabic dialects, constraints, epenthesis, harmony, Optimality Theory

1 Introduction

Research in phonology during the last two decades has securely established that otherwise general processes may be blocked by output constraints. For example, the Obligatory Contour Principle (OCP; Leben 1973, Goldsmith 1976), which prohibits adjacent identical elements, is known to block vowel deletion between identical consonants (McCarthy 1986) or to block high-tone spreading onto a syllable that is adjacent to a high tone (Myers 1987).

In the context of his analysis of tongue root harmony in Palestinian Arabic, Davis (1995) presents evidence that these blocking effects are *process-specific*: the same basic process in different grammars or similar processes in the same grammar can be governed by different constraints or by no constraint at all. Concretely, leftward tone spreading might be blocked by the OCP and rightward tone spreading might ignore it, in the same grammar, on a language-particular basis. To express this observation, Davis proposes, following Archangeli and Pulleyblank (1994),

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that phonological processes are formulated as language-particular rules with a slot available to record any constraints that limit their applicability. That is to say, a constraint that blocks a process is included as a language-particular codicil in the process's formulation (see (3) below for an example).

At the conclusion of his article, Davis says that process-specific constraints, in the sense just described, present a challenge to Optimality Theory (OT; Prince and Smolensky 1991, 1993). OT does not recognize parametric rules with constraints embedded in them. Rather, OT constructs grammars from language-particular rankings of universal constraints. This difference leads Davis to pose the following rhetorical question (p. 495): "[H]ow can the effect of process-specific constraints be produced within Optimality Theory just by constraint ranking, without reference to processes or derivations?" That is, how does OT obtain the effect of process-specific constraints without rules in which to embed the constraints?

The answer to this question is basic to OT and will be the focus here. Reanalysis of the Palestinian Arabic material (in sections 2 and 4) illustrates some important modes of explanation provided by OT. I will show that the conception of constraint interaction inherent to OT is superior to the parametric rule-based theory Davis advocates, yielding a more explanatory account of the material he discusses. This discussion leads to a restrictive claim about the nature of process-specificity under OT (section 3). Finally, in section 5 I address another criticism Davis makes against OT, involving supposed representational commitments in the case of epenthesis.

2 The Simple Blocking Pattern: [RTR] Spread in a Southern Palestinian Dialect

In the southern Palestinian dialect described by Davis, there is bidirectional harmony of the phonological property known traditionally as "emphasis," phonetically a kind of uvularization. This property is identified with the distinctive feature [RTR] (*retracted tongue root*), which is present underlyingly on certain consonants. Leftward harmony of [RTR] is unlimited within the word (1a), whereas rightward harmony is blocked by any of the high front segments *iyšj* (1b–c).¹ (As a transcriptional convenience, I will use underscoring to indicate the extent of the surface [RTR] span and I will capitalize the consonant that underlyingly bears the [RTR] feature. The vowel written as *a* is phonetically [æ], except in an [RTR] span, when it is approximately [ɒ].)

(1) *Southern Palestinian harmony data*

a. Leftward harmony

<u>ballaa</u> S	<u>ħa</u> ḌḌ
<u>ʔabsa</u> T	<u>baa</u> S
<u>ʔa</u> Tšaan	<u>manaafi</u> Ḍ
<u>xayyaa</u> T	<u>našaa</u> T
<u>ta</u> mšiiTa	<u>majaSSa</u> Siš

¹ In order to maintain sharp focus on the issue of process-specificity in OT, I have simply assumed the correctness of Davis's description of the two Palestinian dialects, citing examples and generalizations directly from his article. This limitation inevitably gives short shrift to important questions: is [RTR] the harmonizing feature; are the different harmony

b. Rightward harmony

Sabaah ʔaTfaalTuubak TwaalSootak Seefak

c. Blocking of rightward harmony

Tiinak SayyaadʕaTšaan Ḍajjaat

The forms in (1a) show that leftward harmony of [RTR] is unimpeded even by high front segments like *i* (tamšiiTa). The forms in (1b) show that there is rightward harmony as well, but the examples in (1c) prove that high front segments block rightward harmony. The blockers are *i* (Tiinak), *y* (Sayyaad), *š* (ʕaTšaan), and *j* (Ḍajjaat).

According to Davis, the high front segments block rightward harmony because a process-specific constraint prevents them from linking to [RTR]; since they cannot be skipped over either, they put a stop to harmony. The responsible process-specific constraint can be called RTR/H_i&F_R; it is the conjunction of the constraints RTR/H_i (≡ *[high, RTR]) and RTR/F_R (≡ *[front, RTR]) (after Archangeli and Pulleyblank 1994). The combined constraint RTR/H_i&F_R asserts that [RTR] segments cannot be both high and front.

(2) *RTR/H_i&F_R*

*[high, front, RTR]

In accordance with the model of process/constraint interaction that he adopts, Davis incorporates this constraint directly into the process of rightward [RTR] spread.

(3) *Rightward [RTR] spread in southern Palestinian Arabic* (quoted from Davis 1995:476)

Argument

[RTR]

Parameters

1. Function: INSERT
2. Type: PATH
3. Direction: LEFT TO RIGHT
4. Iteration: ITERATIVE

Structure requirements

1. Argument structure: NONE
2. Target structure: FREE

Other requirements

1. Argument condition: SECONDARY PLACE
2. Target conditions: RTR/H_i and RTR/F_R

processes all phonological, or are some actually phonetic; are the details of blocking and triggering rightly described? For relevant discussion, see Card 1979, Ghazeli 1977, Herzallah 1990, Keating 1990:452ff. McCarthy 1994, and Younes 1982, 1993.

Because this rule includes RTR/H₁&F_R as a ‘‘target condition,’’ rightward spread is blocked whenever it encounters a high front segment (i.e., *iyšj*). But RTR/H₁&F_R is not included in the formulation of the leftward spread rule, which is not subject to any target condition. Thus, the constraint RTR/H₁&F_R is process-specific because it is built directly into the one process it controls. This is the nature of process-specificity in the rule-based parametric framework.

Elaborating on his argument against OT, Davis asks the following question about southern Palestinian (p. 495): ‘‘[H]ow can Optimality Theory account for the fact that rightward emphasis spread, but not leftward emphasis spread, is subject to the grounded conditions RTR/H₁ and RTR/F_R, under the view that these conditions are general constraints of the language and not process specific?’’ Undoubtedly, OT does not countenance complex language-particular rule schemata like (3), with a parametric slot in which the process-specific constraints can reside. The challenge, then, is to see whether OT can obtain the process-specificity effect by other means.

In fact, this situation presents no challenge to OT. Constraint ranking, the essential element of OT, straightforwardly leads to situations in which some processes are blocked by a constraint and others are not. To prove this point, I will outline the main elements of an OT analysis of the southern Palestinian material in (1).

OT does not characterize processes in terms of operations like (3). Rather, in OT the operational notion of a process roughly translates into a constraint ranking in which some structural constraint \mathcal{M} crucially dominates some faithfulness constraint \mathcal{F} : $\mathcal{M} \gg \mathcal{F}$. The constraint \mathcal{M} prohibits some kind of output structure, such as a coda, a nonbranching foot, or a front round vowel; taken together, the various constraints like \mathcal{M} constitute the universal theory of markedness. On the other hand, \mathcal{F} is one of the family of constraints that demand faithfulness of surface forms to underlying forms. When \mathcal{F} is obeyed, surface and underlying forms are identical in the \mathcal{F} -relevant characteristic; when \mathcal{F} is violated, they differ in that characteristic. The ranking $\mathcal{M} \gg \mathcal{F}$ asserts that obedience to \mathcal{M} is required even at the expense of violation of \mathcal{F} , so unless some higher-ranking constraint vitiates the force of \mathcal{M} , any potential \mathcal{M} -violating form will be altered to an \mathcal{M} -conforming one, even if this means unfaithfulness with respect to \mathcal{F} . This unfaithfulness in the underlying \Rightarrow surface mapping, required by constraint interaction under $\mathcal{M} \gg \mathcal{F}$, is the approximate OT analogue to a ‘‘process’’ in operational theories.²

Turning from these abstract considerations to more concrete ones, we can apply the $\mathcal{M} \gg \mathcal{F}$ schema to [RTR] harmony in Palestinian Arabic. The relevant faithfulness constraint is IDENT-ATR: assuming full specification, a segment that is underlyingly [ATR] (*advanced tongue root*) must remain so.³ It is crucially dominated by structural constraints that demand harmony of the

² Under the opposite ranking, $\mathcal{F} \gg \mathcal{M}$, the structural constraint does not affect the underlying \Rightarrow surface mapping. Nonetheless, it may still be active when the dominating constraint \mathcal{F} is irrelevant. This situation, dubbed ‘‘emergence of the unmarked’’ in McCarthy and Prince 1994, derives from the OT claim that constraints are universal but their ranking differs from grammar to grammar (Prince and Smolensky 1993).

³ Under Correspondence Theory (McCarthy and Prince 1995), IDENT-ATR is formalized as in (i). (The string S_1 is the input; S_2 refers to the output.)

(i) IDENT-ATR


If $\alpha \in S_1$, $\beta \in S_2$, $\alpha \mathfrak{M} \beta$, and α is [ATR], then β is [ATR].

As defined, this constraint presupposes full specification of S_1 and S_2 . An appropriate modification for underspecificational assumptions can be readily accommodated: replace ‘‘is [ATR]’’ with ‘‘is not [RTR],’’ in both instances.

Tableau 1RTR-LEFT \gg IDENT-ATR

	/ballaaS/	RTR-LEFT	IDENT-ATR
a. 	<u>ballaa</u> S		****
b.	ballaaS	*!***	

Tableau 2RTR-RIGHT \gg IDENT-ATR

	/Sabaah/	RTR-RIGHT	IDENT-ATR
a. 	<u>Sabaah</u>		****
b.	Sabaah	*!***	

feature [RTR], whenever that feature is present in a form. Following proposals by Akinlabi (1994, 1995, to appear), Beckman (1994), Cole and Kisseberth (1994), Kirchner (1993), Pulleyblank (1993, 1994), and Ringen and Vago (1995, to appear), I will formulate these harmony constraints in terms of the Generalized Alignment model of McCarthy and Prince (1993a).⁴ The responsible high-ranking constraints in southern Palestinian are these:

(4) *Constraints on [RTR] alignment*

a. RTR-LEFT

Align([RTR], Left, Word, Left)

“Any instance of [RTR] is aligned initially in Word.”

b. RTR-RIGHT

Align([RTR], Right, Word, Right)

“Any instance of [RTR] is aligned finally in Word.”

The $\mathbb{M} \gg \mathbb{F}$ ranking is proven by the constraint tableaux 1 and 2. (In these tableaux and others, I have reckoned violations of alignment and faithfulness in terms of feature-geometric root nodes, so *aa* and *a* both count as one; but nothing hinges on this detail, since only the degree of violation matters.) In tableau 1, satisfaction of RTR-LEFT is bought at the price of unfaithfulness to the [ATR] specifications of *b*, *a*, *l*, and *a*; the alternative candidate, with [RTR]-in-situ, fails because the alignment constraint is top-ranked. Tableau 2 shows the same thing, mutatis mutandis, for the constraint RTR-RIGHT.

As these ranking arguments make clear, alignment of [RTR] takes precedence over faithfulness to the input, securely establishing the constraint ranking given in (5).

(5) *Ranking of core constraints in southern Palestinian*

RTR-LEFT, RTR-RIGHT \gg IDENT-ATR

⁴ For an alternative, see Beckman 1995, in preparation.

Tableau 3

RTR-LEFT >> RTR/Hi&Fr

	/xayyaaT/	RTR-LEFT	RTR/Hi&Fr
a. \mathbb{M}	xayyaaT		*
b.	xayyaaT	*!***	

Tableau 4

RTR/Hi&Fr >> RTR-RIGHT

	/Sayyaad/	RTR/Hi&Fr	RTR-RIGHT
a. \mathbb{M}	Sayyaad		***
b.	Sayyaad	*!	

This much lays the foundation for the discussion of how OT obtains the process-specific blocking effect. The rest is quite straightforward, once the role of constraint ranking is made clear. The ranking between two structural constraints, like the ranking between \mathbb{M} and \mathbb{F} , determines which is obeyed and which is violated in case of conflict. The interesting conflicts are between the [RTR] alignment constraints and the featural constraint RTR/Hi&Fr (\equiv *[high, front, RTR]). Leftward harmony proceeds with total disregard for the creation of offending segments, indicating that RTR-LEFT dominates RTR/Hi&Fr, as tableau 3 shows. Under this ranking, RTR/Hi&Fr is irrelevant to the satisfaction of RTR-LEFT.

On the other hand, the ranking of RTR/Hi&Fr with respect to RTR-RIGHT is just the opposite, as shown by tableau 4. Under this ranking, satisfaction of RTR/Hi&Fr blocks the process of rightward [RTR] harmony.⁵ Playing on a terminological ambiguity, one might say that the high front segments are blockers, in the autosegmental sense, of [RTR] harmony—because they cannot become [RTR] themselves without violating high-ranking RTR/Hi&Fr. (Nor can they be skipped over, as in **Sayyaad*. Outcomes like this are excluded by a high-ranking constraint NO-GAP (Kiparsky 1981, Levergood 1984, Archangeli and Pulleyblank 1994), just as in Davis's analysis.)

In summary, the constraint hierarchy motivated by these arguments is as follows:

(6) *Full ranking for southern Palestinian*

RTR-LEFT >> RTR/Hi&Fr >> RTR-RIGHT >> IDENT-ATR

This ranking yields the desired pattern of process-specific blocking. The constraint responsible for rightward harmony is dominated by RTR/Hi&Fr, limiting its influence. The constraint responsible for leftward harmony itself dominates RTR/Hi&Fr, so leftward harmony can affect *all* segments, even those that are high and front. Thus, RTR/Hi&Fr is process-specific, in just the required way. Process-specificity follows from the ranking of constraints, in an entirely unremarkable application of OT.

⁵ See Prince and Smolensky 1993:chap. 4 and Myers 1995 for detailed discussion of such blocking configurations.

The constraint hierarchy in (6) can be used to give a general picture of process-specific constraint limitation, thereby fully answering Davis's assertion that process-specificity is impossible in OT. Suppose a grammar has two structural constraints M_i and M_j , both of which crucially dominate some appropriate faithfulness constraint. Suppose too there is a structural constraint C that stands between them in the ranking.

(7) *Ranking for process-specific constraint interaction*

$$M_i \gg C \gg M_j \gg F$$

Under this ranking, the activity of M_j is mitigated by higher-ranked C , and the activity of M_i is unhindered by C . The constraint C , then, is "process-specific" to the $M_j \gg F$ interaction, but specificity is achieved through language-particular ranking rather than language-particular parameterization. The ranking for southern Palestinian [RTR] harmony in (6) is simply a specific instance of this general schema.

From this schema and the analysis of southern Palestinian, it emerges that nothing special is required to obtain the effect of process-specific constraints in OT. The only mechanism invoked is constraint ranking, which is the sole essential and fundamental element of the theory. In other words, process-specific constraints emerge from OT's most basic assumption.

What leads Davis to conclude otherwise? He asserts (p. 495) that "general constraints on the language" are the only alternative to parametric process-specificity as in (3). In his view, OT posits only "general constraints on the language," whose scope cannot be limited to one process or the other.

A basic misconception about OT is at work here. It holds that constraints in OT are *on* or *off* categorically, so that all *on* constraints must be generally true of the language. The *on/off* notion makes sense in rule-based parametric theories, but not in OT. Because constraints are ranked, there is no privileged class of constraints that are activated—there is only the constraint hierarchy, which may support or blunt the force of a constraint in one circumstance or another.

This misconception about OT is an instance of what McCarthy and Prince (1994) call "the fallacy of perfection." Succinctly, the fallacy says "optimality = perfection"; in the particular case McCarthy and Prince discuss, the fallacy leads to the assertion that, if OT were correct, all words in all languages would be pronounced as *ba* (Chomsky 1994), since *ba* achieves supposed perfection on dimensions of unmarkedness. But unmarkedness stands in fundamental conflict with faithfulness, as the discussion above has emphasized (also see in particular Prince and Smolensky 1993:chap. 9). The *ba* fallacy disregards the role of faithfulness constraints in the evaluation of forms, promoting unmarkedness above all else. Moreover, it disregards the possibility of conflict *among* the structural constraints and *among* the faithfulness constraints. Thus, the *ba* fallacy wrongly presupposes that perfection can be achieved on every dimension—by ignoring constraint conflict and constraint ranking, the very essence of the theory.

In Davis's interpretation of the Palestinian case, the fallacy puts constraints like RTR/H1&FR at the pinnacle of the hierarchy, requiring perfection on that dimension. This misconceived version of OT also fails, because it too ignores the consequences of constraint ranking.

We have now seen how OT obtains the process-specific constraint effect without building

the constraint into the formulation of the process as the parametric rule-based approach does. In section 3, we will see that this property of OT leads to a more restrictive, and hence more interesting, view of process-specificity than the parametric theory. First, though, a few details must be mentioned. They are tangential to process-specificity, but they are necessary in a complete OT account of southern Palestinian [RTR] phonology. The details include (a) constraint conjunction and RTR/HI&FR, (b) additional faithfulness effects, and (c) [RTR] in the phonemic inventory. I will briefly consider each of them.

(a) In Archangeli and Pulleyblank 1994, the interaction of tongue root and tongue body position is seen in terms of two distinct constraints: RTR/HI (\equiv *[high, RTR]) and RTR/FR (\equiv *[front, RTR]). Davis's rule (3) conjoins these two constraints in a single parametric slot. Conjunction of the two constraints is also important in the OT analysis (6).

Constraint conjunction is somewhat unexpected and arbitrary in a parametric theory with rules like (3); why can these parameter values combine, but not others? As precedent, Davis cites Archangeli and Pulleyblank's (1994:412) analysis of Lango, which also invokes constraint conjunction. Significantly, though, Archangeli and Pulleyblank work out their analysis of constraint conjunction in Lango *within* OT. Constraint conjunction is a natural extension of OT and has been much studied in the OT literature (Smolensky 1993, Prince and Smolensky 1993:chap. 5, Hewitt and Crowhurst 1995).

It makes sense to conjoin RTR/HI and RTR/FR because they both say that it is hard to constrict the pharynx when the tongue body is being pulled in the wrong direction (superiorly or anteriorly). Constraint conjunction is synergistic: if combining [RTR] with high *or* front is prohibited, then a fortiori combining [RTR] with high *and* front is prohibited. This yields the following universal ranking:

(8) RTR/HI&FR \gg RTR/HI, RTR/FR

OT captures the synergistic character of constraint conjunction by providing tools for combining linguistic scales; see the literature just cited for discussion.

(b) So far, we have only considered candidates where the underlying [RTR] segment is also [RTR] at the surface. But imagine a candidate derived from /xayyaaT/ with [RTR] detached from the final /T/ and reattached to the initial /x/. This output would equally well satisfy RTR-LEFT, and it would do so without associating [RTR] to y, thereby sparing violation of RTR/HI&FR. Facts like this show the need for a high-ranking faithfulness constraint IDENT-RTR, the symmetric counterpart of IDENT-ATR. In particular, IDENT-RTR crucially dominates RTR/HI&FR.

(c) OT proposes to derive the properties of underlying structures from the same grammar that determines surface structures, so a full analysis of the phonology of [RTR] would have to define its role in the phonemic system. The reasoning behind this and the necessary analytic techniques can be found in the OT literature, including Prince and Smolensky 1993:chap. 9, McCarthy and Prince 1995:279–281, Kirchner 1995, and Itô, Mester, and Padgett 1995. Also see Stampe 1972.⁶

⁶ The details of [RTR] contrast in Palestinian Arabic are quite complex; see Younes 1982 and Herzallah 1990 for

3 An Impossible Blocking Pattern: [RTR] Spread in a Hypothetical System

It is worthwhile to reflect a bit on the schema for a process-specific constraint interaction (7). Suppose top-ranking M_i is also subject to some specific limitation expressed by a constraint L . This means that L dominates M_i , by familiar reasoning. But constraint domination is a transitive relation. Since we already have $M_i \gg M_j$, it follows that L dominates M_j . From these considerations, we obtain the following schema for process-specificity in OT, due to Alan Prince (personal communication):

(9) *General schema for process-specificity*

$$L \gg M_i \gg C \gg M_j \gg F$$

Any constraint that dominates M_i also dominates M_j , because constraint ranking is a strict order on the constraints of Universal Grammar—it is an irreflexive, asymmetric, and transitive relation. Thus, as Prince observes, it is a general fact about OT that no constraint can be process-specific to *just* the M_i -related process in (9); it must, in principle, be able to influence the M_j -related process as well. Whether or not this ability-in-principle is actually observable depends on details of the particular phenomena involved. Observations will be easiest to make when the two processes are similar, as in Palestinian Arabic.

Prince further notes that the general schema (9) motivates a *subset criterion* for process-specificity in OT: if $M_i \gg M_j \gg F$, then the set of constraints that can, in principle, impinge on M_i is a subset of the set of constraints that can, in principle, impinge on M_j . The subset

data and analysis. Davis does not address most of the particulars, and neither will I, but I will briefly mention an issue that comes up in this connection.

Assume that Palestinian has a class, X , of segments that never contrast in [RTR]. (Traditionally, X is said to be [–coronal].) In OT terms, that assumption motivates something like the following statement: the structural constraint *[RTR, X] crucially dominates the faithfulness constraint IDENT-RTR. We have, however, previously established that IDENT-RTR dominates RTR/Ht&Fr, which itself dominates RTR-RIGHT. By transitivity of domination, then, *[RTR, X] must dominate RTR-RIGHT—which means that the segments in the X class should be blockers of rightward [RTR] harmony. But the only actual blockers of rightward harmony are the high front segments, already given by RTR/Ht&Fr. Therefore, we have to conclude one of two things: (a) the class X is null, and in principle any segment can contrast in [RTR]; or (b) the constraints or their rankings are wrongly understood in certain details.

In fact, the set X may indeed be null; the observations are somewhat delicate to interpret. Though the principal bearers of [RTR] contrast in Palestinian Arabic are the historical ‘‘emphatic’’ consonants, all of which are coronal obstruents, there is a small but stable body of words with contrastive [RTR] but no coronal obstruent: *ʔalla* ‘Allah’, *ʔalmaʔni* ‘German’, *lamba* ‘lamp’, *baaba* ‘Pope’, *yaaba* ‘oh, my father!’, *yamma* ‘oh, my mother!’, *mayyi* ‘water’. This set includes native words and assimilated loans (witness the *b* for *p* in *baaba*, from Italian). The existence and stability of this class may indicate that the historical situation is no longer pertinent, and that there is no synchronically valid generalization about X .

If further empirical investigation should confirm the validity of X , however, then we must reexamine some of the constraints and ranking results. In particular, we should question the subhierarchy IDENT-RTR \gg RTR/Ht&Fr, which lies at the core of the presumptive ranking paradox. This subhierarchy derives from the assumption that harmony is based on alignment and that good alignment would be achieved just as well by moving (or deleting) [RTR] as by spreading it, were it not for the intervention of high-ranking IDENT-RTR. But alternative conceptions of harmony are possible and may be desirable; for example, the view of harmony as a perceptual salience effect, mentioned in footnote 11, puts harmony securely into the faithfulness system: if [RTR] is present in the input, then it must be spread in the output. This view of harmony renders IDENT-RTR irrelevant to determining the scope of spreading, and so it eliminates the ranking paradox.

relation can be improper, if $\mathbb{C} = \emptyset$ in (9), and it can be trivial, if $\mathbb{L} = \emptyset$. To put the matter differently, there is a sense in which the \mathbb{M}_i -related process is more robust—or not less robust—than the \mathbb{M}_j -related one.⁷ These are not special stipulations that OT makes about process-specificity. Rather, they derive from the most fundamental element of the theory, constraint ranking.

This result is of more than passing interest, for two reasons. First, a parametric rule-based theory, incorporating statements like (3), makes no such claim about process-specificity. Since each process includes constraints as arbitrary parameters, no prediction is made about how constraints on two different processes in the same grammar will be related. In this respect, the parametric rule-based model is less restrictive than OT, in that it incorporates nothing like the subset criterion. Indeed, given the freedom of parameter setting that is intrinsic to the approach, it is impossible to see how the parametric model could even stipulate, much less derive, the subset criterion.

Second, the subset criterion bears directly on one of Davis's challenges to OT (p. 495): "Relatedly, how would Optimality Theory analyze a possible dialect in which rightward spread of emphasis is subject to one grounded condition whereas leftward spread is subject to a different grounded condition? If such a dialect were reported, it would be potentially problematic for an Optimality Theory account." Indeed it would. If the constraints introduced in section 2 are rightly conceived, then the logic of the subset criterion predicts that *no* grammar could achieve the type of process-specificity described in this hypothetical case.

To put the issue in less abstract terms, let us examine a grammar for the hypothetical system Davis describes. Rightward harmony is limited by just one constraint (say, RTR/H_i) and leftward harmony is limited by another (say, RTR/F_r). Thus, all and only high segments block rightward harmony, and all and only front segments block leftward harmony. The rankings required are these:

(10) *Mutually incompatible constraint rankings required in hypothetical case*

Ranking	Interpretation
a. RTR/H _i >> RTR-RIGHT	High segments block rightward harmony.
b. RTR-RIGHT >> RTR/F _r	Front segments don't block rightward harmony.
c. RTR/F _r >> RTR-LEFT	Front segments block leftward harmony.
d. RTR-LEFT >> RTR/H _i	High segments don't block leftward harmony.

Following the chain from (10a) to (10d), we see that the rankings are circular, contradicting the fundamental premise that constraint ranking is a total ordering. Therefore, no grammar meeting all of (10) can exist in OT. To put the result more intuitively, the set of constraints impinging on rightward harmony in this case is not a subset or superset of the set of constraints impinging on leftward harmony, so the subset criterion is not met, either way. The predicted impossibility

⁷ The ranking RTR-LEFT >> RTR-RIGHT, required in both Palestinian dialects, is perhaps to be related to the well-known bias for anticipatory over perseverative coarticulation.

of this hypothetical system shows that there is truly a restrictive claim here; the subset criterion sets an irreducible limit on how specific a constraint on a process can be in OT.

This argument shows that the definition of ranking, which is the central element of OT, has highly restrictive consequences for the character of process-specific constraint interactions. Related processes are rankable for a kind of robustness that may be seen from any proper subset relations among constraints that limit their effect. In contrast, parametric rule-based theories make no such prediction. If arbitrary process-specific constraints are included as parameters in the processes themselves, as in (3), then any process can be governed by any constraint, without regard to other processes coexisting in the grammar. Davis's example of this type of process-specificity is hypothetical, whereas both of the real dialects he discusses meet the subset criterion (see sections 2 and 4). The inference, then, is that the OT model of process-specificity is not only more restrictive but also empirically correct.⁸

4 Another Blocking Pattern: [RTR] Spread in a Northern Palestinian Dialect

At first glance, rightward [RTR] harmony in northern Palestinian Arabic appears not to meet the subset criterion. (Leftward harmony is identical in northern and southern Palestinian and will not be discussed further here.) Two processes of rightward harmony are involved, with apparently disjoint conditions on applicability. (As in section 2, I cite the examples from Davis 1995; in this case Davis bases his work on Younes 1982, 1993 and Herzallah 1990, which should be consulted for additional details and insights.)

(11) *Northern Palestinian local rightward harmony*

- a. To immediately following *a*

<u>Ta</u> a z a	<u>S</u> a b a a ħ
<u>Ḍ</u> a l a m	<u>m</u> a n Ta k a

- b. To immediately following *Ca*

<u>ʔ</u> a Ḍ a m	<u>S</u> n a a f
--	--

⁸ An anonymous reviewer avers that this restrictive prediction of OT holds true only in a monostratal implementation but not in a multistratal one. If a single language contains several serially connected OT grammars, each with its own constraint hierarchy, it might be possible to get the descriptive effect of Davis's hypothetical dialect in the ultimate output, even though no individual stratum can support the mutually incompatible rankings in (10).

The reviewer's comment confounds description with explanation. Properly speaking, an OT grammar is a ranking of universal constraints, like (6), whereas a parametric rule-based grammar consists of (an ordering of) expressions like (3). Process-specificity must meet the subset criterion in the OT grammar, but not in the parametric rule-based one. These are established results about the kinds of *explanations* the two theories do or do not provide. They are not touched by the observation that, *descriptively*, a multistratal implementation of OT may be able to simulate some kinds of process-specificity without the subset criterion. The parametric rule-based theory makes no such restrictive prediction, with or without multiple strata.

Two further remarks. First, it is by no means obvious that multistratal OT is even necessary; much of the *prima facie* evidence for it has been reanalyzed in monostratal terms by Benua (1995, in preparation) and others. Second, when all the constraints of UG are considered, the differences in ranking between the two stratal grammars that are necessary to simulate process-specificity will very likely have unintended side effects, making exact simulation of the rule-based analysis impossible.

- c. Blocked by following high segment

<u>ʕaTʃaan</u>	<u>Syaam</u>
<u>Twaal</u>	<u>Sihha</u>
<u>kaTTuuʕa</u>	

(12) *Northern Palestinian long-distance rightward harmony*

- a. To following sequence of *a* and laryngeals (*ʔ, h*) or pharyngeals (*ʕ, ħ*)

<u>maSlaha</u>	<u>Sahhaaha</u>
<u>Taʕnak</u>	<u>Sahnak</u>
<u>Sahan</u>	<u>Sahhab</u>
<u>Taaʕan</u>	

- b. Blocked by following high segment

<u>Sihha</u>	<u>kaTTuuʕa</u>
--------------	-----------------

There is local rightward harmony onto the next vowel nucleus, including any intervening consonant, as long as no violations of RTR/H_i (\equiv *[high, RTR]) ensue. There is also unbounded rightward harmony onto a sequence of low segments, a class that in Palestinian includes the vowel *a* and the laryngeal and pharyngeal gutturals (McCarthy 1994). Observe from (12b) that long-distance harmony, which targets only low segments, is supererogatorily blocked by high segments as well.

In Davis's analysis, there are two separate rules of rightward harmony, each with its own target constraint included in the formulation. Local harmony applies first, and it includes among its parameters the constraint RTR/H_i. Long-distance harmony applies to the output of local harmony, and it parametrically includes the constraint RTR/LOWER-VT ('If [RTR], then Lower-VT'), which requires the segment targeted by spreading to bear a Lower Vocal Tract node—that is, it must be a pharyngeal segment (a low vowel or a guttural consonant).⁹

Concerning northern Palestinian, Davis asks (p. 495), "[H]ow would Optimality Theory account for the fact that the two different rules governing rightward spread of [RTR] . . . are subject to two different target conditions?" If this characterization is correct—two different processes subject to two different constraints—then the constraints governing one process are not a subset of the constraints governing the other. At first glance, then, it appears that the subset criterion is not met in northern Palestinian, because local rightward harmony is governed by one constraint, RTR/H_i, and long-distance rightward harmony is governed by a different constraint, RTR/LOWER-VT. Since the subset criterion is an unavoidable consequence of constraint ranking, this result imperils the very foundations of OT.

First appearances, though, prove wrong on closer inspection. Long-distance rightward har-

⁹ Davis (1995:(10)) proposes that the feature [RTR] is feature-geometrically dependent on Lower-VT. Accordingly, when rules like (3) spread [RTR] onto segments that lack a Lower-VT node, one is generated automatically to maintain consistency of feature-geometric structure. This operation of Node Generation is a standard assumption in the framework Davis adopts (Archangeli and Pulleyblank 1994:23).

Given Node Generation, though, RTR/LOWER-VT should be vacuous as a target condition on long-distance [RTR] spread. Since Node Generation always supplies Lower-VT as needed, how could this constraint ever block anything? In

mony can be governed by *both* RTR/H_i and RTR/LOWER-VT, as the subset criterion predicts. The situation becomes clearer once we look past the names of these constraints to their substance. RTR/H_i says “If [RTR], then not high,” whereas RTR/LOWER-VT says “If [RTR], then Lower-VT.” Since the segments with a Lower-VT node (*a* and the gutturals) are a proper subset of the nonhigh segments, any segment that satisfies RTR/LOWER-VT will also satisfy RTR/H_i. In (13), I have made this same point in more familiar terms, so the syllogistic character of the argument is clear.

(13) *Logical relation between RTR/H_i and RTR/LOWER-VT*

RTR/H _i	[RTR] \supset [– high]
RTR/LOWER-VT (approximately)	[RTR] \supset [+ low]
According to Chomsky and Halle 1968	[+ low] \supset [– high]
	\therefore RTR/LOWER-VT(s) \supset RTR/H _i (s), for any segment <i>s</i> .

In this case, the constraints themselves are in a subset relation. Therefore, imposing RTR/H_i on long-distance rightward harmony, as the subset criterion requires, does not change the effect that RTR/LOWER-VT exerts on the same process.

Putting these results together with the schema for process-specificity in (9), we obtain the following ranking for northern Palestinian:

(14) *Schematic ranking for [RTR] harmony in northern Palestinian Arabic*

RTR/H_i \gg \mathbb{M}_i \gg RTR/LOWER-VT \gg \mathbb{M}_j \gg \mathbb{F}

The ranking \mathbb{M}_i \gg \mathbb{F} characterizes the process of *local* rightward spreading, which is blocked only by RTR/H_i (see (11)). The ranking \mathbb{M}_j \gg \mathbb{F} characterizes the process of *long-distance* rightward spreading, which is blocked by both RTR/LOWER-VT and RTR/H_i (see (12)). As I just argued, top-ranked RTR/H_i neither adds nor detracts from the effect of RTR/LOWER-VT on \mathbb{M}_j , so the subset criterion for process-specificity is in fact met.

We have seen, then, that the northern Palestinian data, far from arguing against OT, support the more restrictive view of process-specificity that ranking gives. To reiterate the point of section 3: a parametric rule-based theory says nothing about which constraints might limit two different processes in the same grammar, whereas OT, because of ranking, insists that the constraints impinging on one process must be a subset of the constraints impinging on another.

response, Davis (personal communication) has suggested that Node Generation applies in situations involving antagonistic target conditions (like RTR/H_i) but not sympathetic ones (like RTR/LOWER-VT). This move does not seem to be independently motivated, however.

For simplicity, I adopt the null hypothesis, that specifications for [RTR] and Lower-VT are feature-geometrically independent, so a segment can be just [RTR] ($\underline{\mathfrak{s}}$), just Lower-VT (*h*), or both ($\underline{\mathfrak{h}}$). If the nonnull assumption should turn out to be correct, however, then RTR/LOWER-VT must be replaced. Two plausible alternatives are (a) a constraint defined as “If [RTR], then primary pharyngeal,” which correctly limits the [RTR] class to the gutturals and *a*, or (b) DEP(LOWER-VT), which militates against “adding” Lower-VT to a segment (cf. McCarthy and Prince 1995).

Though this is all I will have to say about process-specificity, there is an analytic detail to be settled: what are the actual constraints \mathbb{M}_i and \mathbb{M}_j in (14)? The constraint implicated in long-distance harmony, \mathbb{M}_j , is just RTR-RIGHT, as in the southern Palestinian dialect. The constraint \mathbb{M}_i is involved in the local harmony process, which spreads [RTR] no further than a following (C)V sequence. Unlike long-distance harmony, local harmony processes like this one have been little studied in the phonological literature, in OT or otherwise.¹⁰ It is not unexpected, then, that Davis's rule-based analysis must fall back on descriptive stipulation, iterating a local harmony process "to a following syllable nucleus" (Davis 1995:487–488). Descriptive stipulation is never desirable, though—much less so in an OT grammar, where each constraint is universal and, through ranking permutation, will participate in determining a range of typological options.

What is required, then, is a crosslinguistic examination of similar local harmony phenomena. Until this project is undertaken, we can only speculate about what constraint fills the role of \mathbb{M}_i in (14). One possibility is that the responsible constraint requires any [RTR] span to end on the vowel *a*. This makes sense because *a* is exactly where [RTR] is most salient perceptually, since it produces an obvious distinction between [æ] and [ɐ].¹¹ Obedience to such a constraint will yield the desired local rightward harmony in forms like *Sabaah* or *ʔaḏlam*, and it is inoffensive to long-distance harmony cases like *Saḥḥaaha*, where the [RTR] span also ends on *a*.

For explicitness, I will formulate this constraint in alignment terms, like RTR-LEFT and RTR-RIGHT.

- (15) *RTR-TO-a*
Align([RTR], Right, *a*, Right)

Inserting it into the hierarchy (14), together with the other constraints discussed, we obtain a fairly full picture of [RTR] harmony in the northern Palestinian dialect.

- (16) *Hierarchy for [RTR] harmony in northern Palestinian Arabic*
IDENT-RTR, RTR-LEFT >> RTR/Hi >> RTR-TO-a >> RTR/LOWER-VT >> RTR-RIGHT
>> IDENT-ATR

The top-ranked constraints can compel violation of RTR/Hi, which itself is in a position to block RTR-TO-a (as in (11c)). Satisfaction of RTR-TO-a is not limited by lower-ranked RTR/LOWER-VT, which nevertheless does control the effect of RTR-RIGHT. At the bottom is the faithfulness constraint IDENT-ATR, violated in every case of [RTR] harmony.

Compare this constraint hierarchy with that of southern Palestinian. The gross ranking structure is the same in both dialects, with undominated IDENT-RTR and RTR-LEFT at the top, IDENT-ATR at the bottom, and RTR-RIGHT in between. One difference is that RTR/LOWER-VT dominates

¹⁰ Explicit discussions of this general problem include Poser 1982, Archangeli and Pulleyblank 1987, 1994, Myers 1987, 1995, and Itô, Mester, and Padgett 1995.

¹¹ This attraction of [RTR] to *a* can perhaps be connected with Cohn's (1995) idea that phonological specifications must be saliently realized, with ideas about perceptual salience in Optimal Domains Theory (Cole and Kisseberth 1994), and with Kaun's (1995) proposal that a function of harmony is to maximize the perceptual salience of otherwise hard-to-hear contrasts.

Tableau 5*/Sabaah/ – Sabaah (see (11a))*



<i>/Sabaah/</i>	IDENT- RTR	RTR- LEFT	RTR/HI	RTR- TO- <i>a</i>	RTR/ LOWER-VT	RTR- RIGHT	IDENT- ATR
a.  <i>Sabaah</i>					*	***	*
b. <i>Sabaah</i>				*!	*	****	
c. <i>Sabaah</i>					**!	*	***
d. <i>sabaah</i>	*!						

Tableau 6*/Snaaf/ – Snaaf (see (11b))*

<i>/Snaaf/</i>	IDENT- RTR	RTR- LEFT	RTR/HI	RTR- TO- <i>a</i>	RTR/ LOWER-VT	RTR- RIGHT	IDENT- ATR
a.  <i>Snaaf</i>					**	*	**
b. <i>Snaaf</i>				*!	*	***	

RTR-RIGHT in northern Palestinian, but the ranking must be just the opposite in southern Palestinian. Domination by RTR/LOWER-VT significantly limits the scope of RTR-RIGHT in the northern Palestinian dialect, leading to long-distance harmony only over strings of low segments. This is a small example of the inherently typological character of OT (Prince and Smolensky 1993), in which differences in constraint ranking, rather than differences in the presence of a rule or the value of a parameter, are what distinguish languages. Another difference is that RTR-TO-*a* is visibly active in northern Palestinian, because it dominates RTR/LOWER-VT. In southern Palestinian, however, there is no observable activity by RTR-TO-*a*, presumably because it too is ranked below RTR-RIGHT.

The full hierarchy for the northern Palestinian dialect is applied to selected examples in tableaux 5 through 9. Tableau 5 shows a case of local harmony, in which [RTR] spreads to the next vowel (an *a*) but no further. Candidate (b), with no harmony whatsoever, fails on RTR-TO-*a*, since the right edge of the [RTR] span is not the vowel *a*. Candidate (c), with long-distance harmony, incurs an avoidable violation of RTR/LOWER-VT, because it contains an [RTR] *b* that no other candidate has. All of (a–c) have at least one violation of this constraint, though, because of the underlying [RTR] ṣ. Form (d) avoids this violation, and moreover satisfies all other [RTR]-controlling constraints, by eliminating the feature entirely, but that violates top-ranked IDENT-RTR. (Having made the point, I will not consider candidates like (d) again.) As in southern Palestinian, undominated NO-GAP bars “skipping” configurations like *Sabaah*.

Tableau 6 is another case of local harmony, but with a consonant included in the [RTR] span. In (b), *n* blocks harmony, satisfying RTR/LOWER-VT but violating higher-ranking RTR-TO-*a*.

Tableau 7 considers the form *ṣaTṣaan*, where rightward harmony is blocked by *ṣ*. The basis of the blocking effect can be seen by comparing (a) and (b). In the latter, high-ranking RTR/HI

Tableau 7

/ʕaTʕaan/ – ʕaTʕaan (see (11c))

/ʕaTʕaan/	IDENT- RTR	RTR- LEFT	RTR/HI	RTR- TO- <i>a</i>	RTR/ LOWER-VT	RTR- RIGHT	IDENT- ATR
a. ʕaTʕaan				*	*	***	**
b. ʕaTʕaan			*!		**	*	****
c. ʕaTʕaan		*!*		*	*	***	

Tableau 8

/Sahhaaha/ – Sahhaaha (see (12a))

/Sahhaaha/	IDENT- RTR	RTR- LEFT	RTR/HI	RTR- TO- <i>a</i>	RTR/ LOWER-VT	RTR- RIGHT	IDENT- ATR
a. Sahhaaha					*		*****
b. Sahhaaha					*	*!***	*

is violated because the high consonant *ʕ* has assimilated to the [RTR] feature. This is fatal, because a candidate is available in (a) that avoids the offending segment just by violating lower-ranked RTR-TO-*a*. Incidentally, (c) shows a case where leftward harmony has failed. Candidates like this were comprehensively examined in southern Palestinian (section 3) and need not be considered further here.

In tableau 8, where the higher-ranking constraints are irrelevant because both candidates satisfy them, we see the pure effect of rightward harmony. Thus, RTR-RIGHT is decisive, just as in southern Palestinian, but here RTR/LOWER-VT ensures that RTR-RIGHT is effective only in sequences of Lower-VT segments.¹²

Finally, tableau 9 is also analogous to the southern Palestinian system. RTR/HI blocks rightward harmony in the expected way, though satisfaction of lower-ranked RTR-TO-*a* could otherwise be achieved.

In summary, I have shown that the phonology of [RTR] harmony in northern Palestinian Arabic exhibits a pattern of process-specificity that meets the subset criterion introduced in section 3. A reasonably complete OT analysis has been presented, in which the limitation of processes by constraints as well as the processes themselves are obtained from the essential element of OT, constraint ranking.

¹² When the string of Lower-VT segments ends in a guttural consonant, rather than *a*, RTR-TO-*a* will prevail over lower-ranking RTR-RIGHT, selecting *Taʕnak* rather than *Taʕnak*. This transcriptional nuance is inconsequential, since impressionistic phonetic evidence cannot tell us whether or not the pharyngeal consonant is [RTR]. If instrumental phonetic evidence should confirm that *Taʕnak* is a more accurate transcription, then RTR-TO-*a* could be replaced by a constraint demanding that the [RTR] span end on a Lower-VT segment, subsuming *a* and the gutturals.

Tableau 9*/Siħħa/ – Siħha (see (12b))*

<i>/Siħħa/</i>	IDENT- RTR	RTR- LEFT	RTR/Hi	RTR- TO- <i>a</i>	RTR/ LOWER-VT	RTR- RIGHT	IDENT- ATR
a. <i>Siħħa</i>				*	*	***	
b. <i>Siħha</i>			*!		**		***

5 The Representation of Epenthetic Segments

Process-specificity is the main point of Davis's article and of this one. Nonetheless, he concludes by raising a very different challenge to OT. It rests on an observation about how epenthesis influences [RTR] harmony. As we have seen, *i* blocks rightward harmony. Blocking occurs whether the *i* is underlying (as in *Tiinak*) or epenthetic (as in *baTinha* from /baTn + ha/).¹³ The problem, according to Davis (p. 496), is this: "In standard Optimality Theory, . . . the site of epenthesis is viewed as an empty syllabic position lacking featural content. The features of a[n epenthetic] vowel . . . are supplied by a later interpretive component. . . ." That is, an epenthetic vowel is supposed to be phonologically featureless, but it acts like any other high vowel in blocking rightward harmony. (Interestingly, Herzallah (1990:109–110fn., 190ff.) argues that epenthetic *i* in northern Palestinian does act like a featureless segment.)

This purported argument against OT rests on a category error, an error that is canonized as "standard Optimality Theory." As the previous discussion has emphasized, OT is about how grammars are defined by constraint hierarchies; it is not about how to represent epenthetic vowels. Thus, no result about the representation or behavior of epenthetic vowels can possibly bear on the correctness of OT per se.

Facts about epenthetic vowels will, of course, bear on the correctness of any theory of epenthetic vowels; this truism applies equally well to a theory of epenthetic vowels embedded within OT. One view of epenthesis has considerable support in the literature: epenthesis is a consequence of excessive syllabification, in which otherwise stray segments may be incorporated into syllables with empty onsets or nuclei (Selkirk 1981, Broselow 1982, Piggott and Singh 1985, Itô 1986, 1989, Lowenstamm and Kaye 1986). The phonetic values of these empty positions are spelled out by rules of default feature insertion, which apply extrasystemically (Archangeli 1984: 36, Broselow 1984, Paradis and Prunet 1991, Herzallah 1990); that is, they are outside the syllabification system, and are often assumed to be outside the (lexical) phonology proper.¹⁴

Some OT work adopts this view of epenthetic segments because it accommodates a purely structural basis for the antiepenthetic faithfulness constraint. Specifically, the constraint FILL is posited, which militates against empty syllabic positions (Prince and Smolensky 1991, 1993,

¹³ Spring (1994) presents a similar argument about the nature of epenthetic consonants: in Axininca Campa, epenthetic *t* behaves no differently from underlying *t* in undergoing palatalization.

¹⁴ Since epenthetic segments are typically unmarked, this assumption is necessary in any theory that equates unmarkedness with underspecification.

McCarthy and Prince 1993b). But this treatment of epenthesis is by no means peculiar or intrinsic to OT, since it both predates OT, as the above references show, and is rejected in other OT work (e.g., Smolensky 1993, McCarthy 1993, McCarthy and Prince 1994, 1995), which develops alternative views of faithfulness based on the epenthetic segment's lack of a morphological affiliation or an underlying correspondent. Davis's argument is appropriate for what it tells us about the representation of epenthetic vowels and, by extension, about the constraint FILL, but it is a category mistake to think that this bears on the correctness of OT.

This spurious challenge to OT is one of many category errors that arise in discussions of the theory. Other examples include these: OT requires that deleted segments be present but syllabically unparsed; OT cannot treat floating tones or empty segments; OT is a theory of prosody only, which cannot deal with segmental phonology; OT is incompatible with (or is *only* compatible with) moraic prosody; OT denies the possibility of distinct lexical and postlexical phonologies; OT says that morphology can impinge on phonology only at constituent edges, through alignment; OT is inherently nonderivational; OT is a theory of phonology only, without relevance to morphology or syntax; OT has, at its peril, discarded all the insights of feature geometry/skeletal theory/metrical theory/lexical phonology/etc. How could any of these things be true *of necessity*, when what OT says is that grammars are defined by constraint hierarchies? These issues have their place in the context of evaluating particular theories of phonology embedded within OT, but there is no such thing as a 'standard OT' account of any of them nor, I think, could there ever be one.

6 Conclusion

In the course of responding to Davis's claim that OT cannot contend with process-specificity of constraints, a result that was always present but only latent has been exposed to view. We have seen that OT provides a general theory of process-specificity through constraint ranking. Moreover, OT demands that process-specificity meet a subset criterion, whose properties were defined in section 3. The essence of the subset criterion is that similar processes can be ranked for robustness, because the constraints impinging on one must be a subset of the constraints impinging on the other. The OT approach is therefore more restrictive and interesting than alternatives that use rules and parameters, since they make no connection between the constraints on different processes in the same grammar. Furthermore, OT obtains these results from minimal assumptions, consisting of nothing more than the core idea of the whole theory: constraints are ranked.

These results about process-specificity in OT derive empirical support from the Palestinian Arabic material. The southern Palestinian pattern is straightforwardly compatible with the subset criterion, and the northern Palestinian pattern is as well, once the constraints involved are properly understood. A hypothetical example that is incompatible with the subset criterion was also discussed, affirming the restrictiveness of the claim OT makes.

Finally, in section 5 I discussed a very different objection against OT, based on a type of category error in which an implementational aspect of some OT analyses is confounded with the essence of the theory itself.

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